



U.S. Geological Survey
National Aeronautical and Space Administration
Certificate of Information
Lunar Highlands Type simulant (Pilot)
LHT-1M

Material used in the preparation of this pilot simulant material was collected under the direction of the USGS in 2007 from the Stillwater Mining Company, located near Nye, Montana. A variety of samples from the mining operations and locations adjacent to the mine were obtained which are believed to represent the various geologic rock types found in the highlands region of the moon. The USGS performed a basic separation of the starting material by visual inspection, followed by blending of selected aliquots based on chemical and mineralogical considerations. Glass and agglutinate production using material from the Stillwater mine was performed at Zybeck Technologies Inc. using a high temperature plasma melter. Glass and mafic components were then combined, processed and bottled at the USGS. Information presented below is based on analyses performed at the USGS, Bureau of Reclamation, and Horiba Instruments Inc.

<u>Element</u>	<u>Mean</u>	<u>s.d.</u>	<u>Oxide</u>	<u>Mean</u>	<u>s.d.</u>
Al, %	12.9	1.0	Al ₂ O ₃ , %	24.4	3.5
Ca	9.38	0.40	CaO	13.1	0.56
Fe (II)	2.55	0.01	FeO	3.30	0.012
Fe _{TOT}	3.35	0.17	Fe ₂ O ₃ T	4.79	0.24
K	0.07	0.01	K ₂ O	0.08	0.01
Mg	5.12	0.29	MgO	8.50	0.48
Na	1.06	0.02	Na ₂ O	1.43	0.03
P	<0.01	-	P ₂ O ₅	<0.02	
S _{TOT}	<0.05				
Si	22.26	0.10	SiO ₂	47.62	0.21
Ti	0.20	0.01	TiO ₂	0.33	0.02

<u>Element</u>	<u>µg/g</u>	<u>s.d.</u>	<u>Element</u>	<u>µg/g</u>	<u>s.d.</u>	<u>Element</u>	<u>µg/g</u>	<u>s.d.</u>
Ag	<2	-	Ge	<1	-	Se	<1	-
As	<30	-	Hf	2	<0.05	Sm	0.25	0.05
Ba	23.0	1.3	Ho	0.08	0.01	Sn	<1	-
Be	<1	-	In	<0.2	-	Sr	106	5
Bi	69	9	La	2.95	0.30	Ta	<0.5	-
Cd	<0.05	-	Li	2.76	0.21	Tb	0.06	0.01
Ce	17.1	2.3	Lu	0.05	0.005	Th	0.31	0.03
Co	29.9	4.1	Mn	600	23	Tl	<0.5	-
Cr	662	62	Mo	3.6	2.5	Tm	<0.05	-
Cs	0.1	0.01	Nb	4.93	0.98	U	0.12	0.03
Cu	38.3	4.1	Nd	1.42	0.08	V	51.7	5.0
Dy	0.38	0.03	Ni	323	14	W	<1	-
Er	0.25	0.02	Pb	1.54	0.23	Y	2.65	0.42
Eu	0.19	0.02	Pr	0.38	0.01	Yb	0.30	0.005
Ga	12.0	0.67	Rb	1.69	0.12	Zn	26.8	3.4
Gd	0.30	0.3	Sb	0.05	0.01	Zr	74.6	4.1
			Sc	10.5	1.4			

Particle Shape analysis (average)

Aspect ratio 0.646
Symmetry 0.823
Sphericity 0.760

Particle size

<u>Sieve size (micron)</u>	<u>% of total mass</u>
> 425	5.78
>150	34.6
>75	27.8
<75	31.8